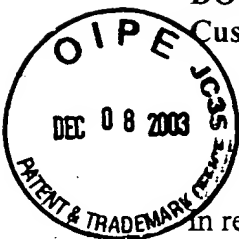


DOCKET NO. 01-P-002 (STMI01-00013)
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PATENT

#15
Appeal
Brief
12/19/03
afj



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: : CHARLES R. SPINNER, III ET AL
Serial No. : 09/871,463
Filed : May 31, 2001
For : BARRIER FILM DEPOSITION OVER METAL FOR
REDUCTION IN METAL DISHING AFTER CMP
Group No. : 2815
Examiner : M.E. Warren

MAIL STOP APPEAL BRIEF - PATENTS

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450



Sir:

APPELLANTS' SUBSTITUTE BRIEF ON APPEAL

Appellants respectfully withdraw Appellants' Brief on Appeal filed June 3, 2003 in the above-identified matter, and submit this substitute brief on Appeal in triplicate on behalf of Appellants. The fee for filing a Brief on Appeal has been previously paid. Please charge any additional necessary fees to Deposit Account No. 50-0208.

REAL PARTY IN INTEREST

The real party in interest for this appeal is the assignee of the application, STMicro-ELECTRONICS, INC. (f/k/a SGS-THOMSON MICROELECTRONICS, INC.).

RELATED APPEALS AND INTERFERENCES

There are no appeals or interferences related to the present application which are currently pending.

STATUS OF CLAIMS

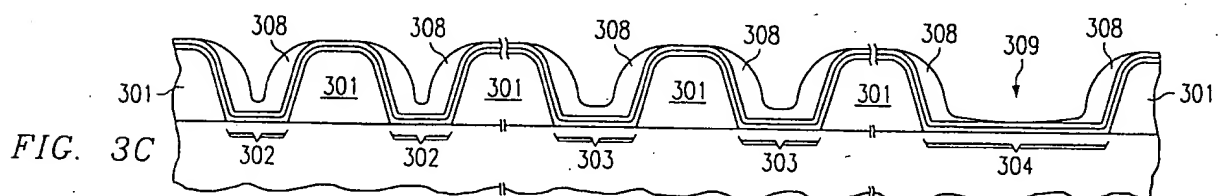
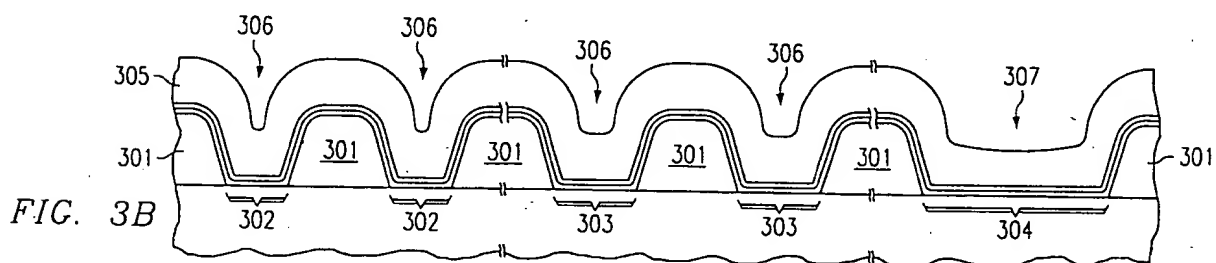
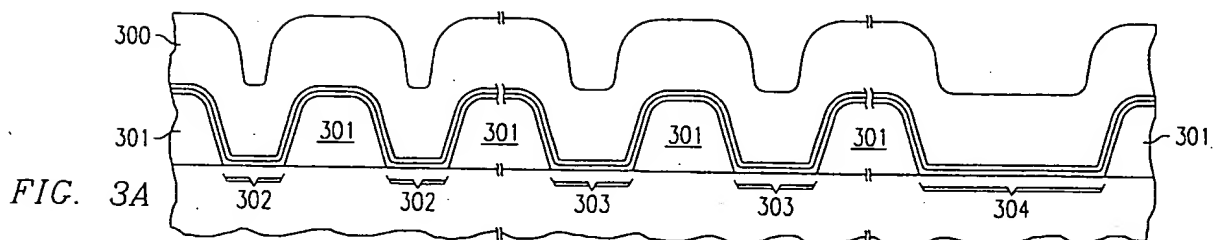
Claims 1–20 are pending in the present application. Claims 1–7 were restricted from claims 8–20 pursuant to 35 U.S.C. §§ 101 and 121 and withdrawn from further consideration. Claims 8–9, 11 and 16–18 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,175,154 to *Gillespie*. Claims 8–14 and 16–18 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,103,625 to *Marcyk et al*. Claims 15 and 20 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Marcyk et al* in view of U.S. Patent No. 6,346,741 to *Van Buskirk et al*. Claim 19 was rejected under 35 U.S.C. § 103(a) as being unpatentable over *Marcyk et al* in view of U.S. Patent No. 6,103,625 to *Joshi et al*. The restriction of pending claims 1–7 and the rejection of pending claims 8–20 is appealed.

STATUS OF AMENDMENTS

No amendments to the claims were submitted following the final Office Action mailed November 19, 2002.

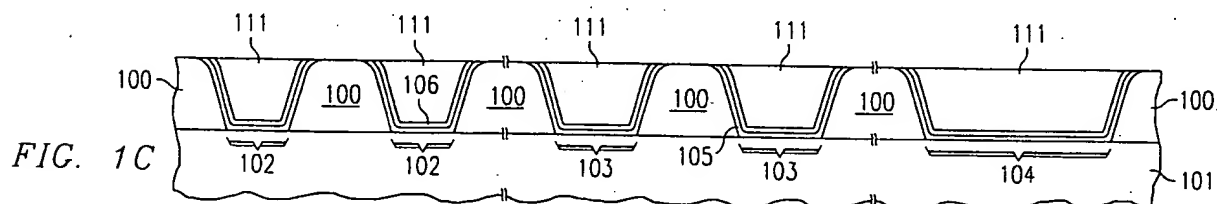
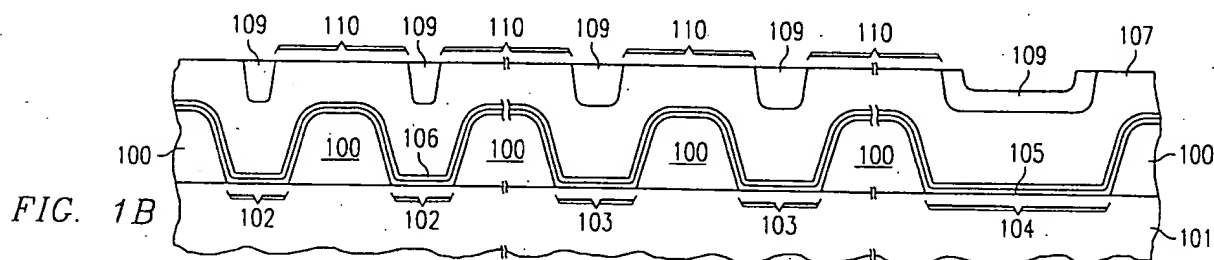
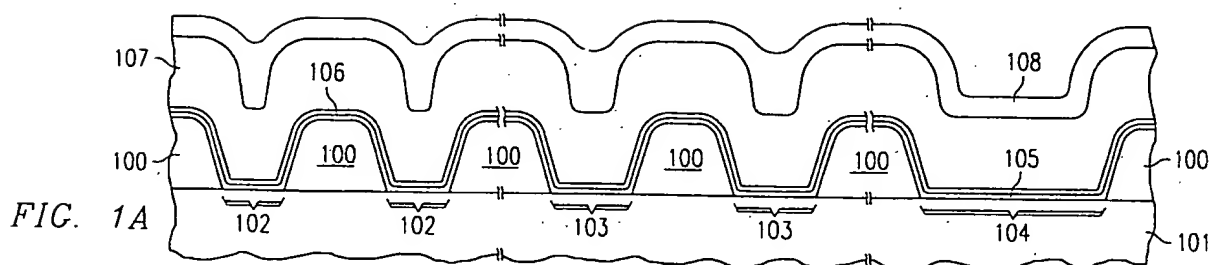
SUMMARY OF THE INVENTION

The present invention relates to chemical mechanical polishing (CMP). For tungsten metal layers within an integrated circuit, chemical mechanical polishing utilizes an abrasive slurry containing a chemical oxidizing the tungsten metal, with the tungsten metal oxide then being (selectively) removed by a combination of abrasion and chemical action. Specification, page 2, lines 19–23. While this produces planar upper surfaces, the typical chemical mechanical polishing process for tungsten is primarily chemical in nature, and therefore results in uniform removal of tungsten, largely independent of topography, rather than being strictly mechanical in nature with higher regions removed before lower regions. Specification, page 3, lines 1–18. A problem of thinning or “dishing” of tungsten layers results, particularly for tungsten regions having a large area, such as a metal-oxide-semiconductor capacitor 304, within a layer including smaller area regions such as contacts 302. A conformal tungsten layer 300 of uniform thickness formed over a dielectric 301 having openings 302–304 therein and patterned or “etched back” by chemical mechanical polishing will thus be thinner over large area openings 304 than over small area openings 302 after chemical mechanical polishing:



Specification, Figures 3A-3C, page 3, line 20 through page 5, line 14.

The present invention reduces dishing during chemical mechanical polishing of conformal tungsten layers. A conformal tungsten layer 107 is formed over a patterned dielectric layer 100 having openings 102-104 therein exposing an underlying substrate layer 101:

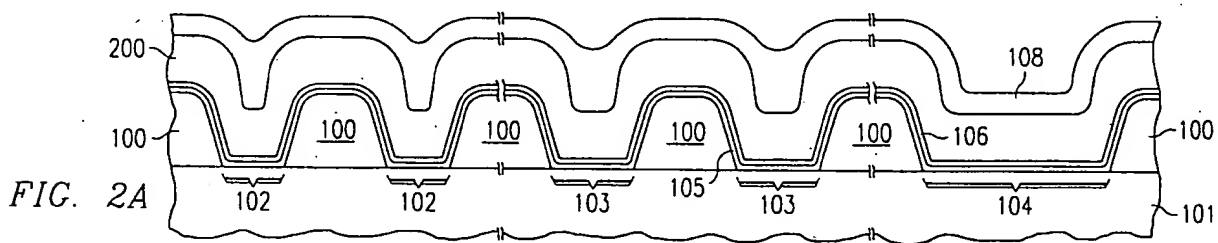


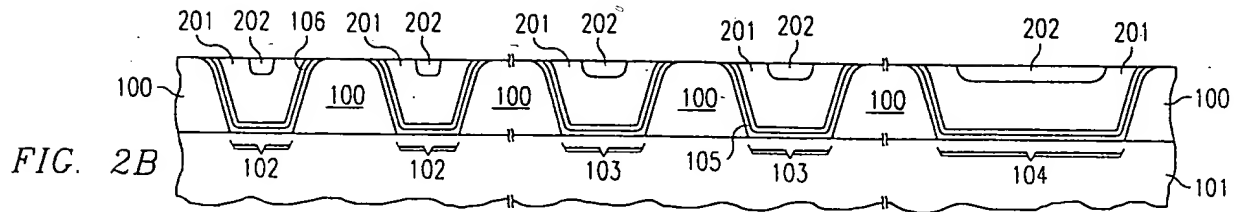
Specification, Figures 1A-1C, page 10, line 19 through page 11, line 3. Openings 102-104 may be of varying widths or areas, such as small or narrow contact openings 102, medium width interconnect grooves 103, and wide capacitive electrodes 104. Specification, page 11, lines 4-16.

A protective barrier layer 108 is formed over the conformal tungsten layer 107, formed from a material such as a titanium nitride (TiN) for which chemical mechanical polishing is primarily

mechanical rather than primarily chemical, such that higher topological regions are removed or “etched back” faster than lower topological regions. Specification, page 11, line 17 through page 12, line 22. During chemical mechanical polishing, the barrier layer 108 reduces dishing by preventing chemical attack of underlying tungsten metal until completely removed in a given area. Specification, page 13, lines 3–14.

In one embodiment of the present invention, where the tungsten layer 107 is thicker than the underlying dielectric layer 100 (i.e., the tungsten layer 107 is thicker than the depth of the unfilled portions of openings 102–104 within dielectric layer 100), the protective barrier layer 108 will be completely removed during chemical mechanical polishing as shown in Figure 1C. Specification, page 13, line 15 through page 14, line 2. In another embodiment, where the tungsten layer 200 is not as thick as the underlying dielectric layer 100, the protective barrier layer 108 is not completely removed during chemical mechanical polishing, and portions 202 of the protective barrier material remain over central portions of each opening 102–104:





Specification, Figures 2A-2B, page 14, line 3 through page 15, line 6. The reduction in dishing achieved by the present invention improves process margins and yield.

ISSUES ON APPEAL

Claims 1-20 are pending in the present application. Claims 1-7 were restricted from claims 8-20 pursuant to 35 U.S.C. §§ 101 and 121 and withdrawn from further consideration. Claims 8-9, 11 and 16-18 were rejected under 35 U.S.C. § 102(e) as being anticipated by *Gillespie*. Claims 8-14 and 16-18 were rejected under 35 U.S.C. § 102(e) as being anticipated by *Marcyk et al*. Claims 15 and 20 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Marcyk et al* in view of *Van Buskirk et al*. Claim 19 was rejected under 35 U.S.C. § 103(a) as being unpatentable over *Marcyk et al* in view of *Joshi et al*. The issues on appeal are:

1. Whether claims 1-7 were properly restricted from claims 8-20 pursuant to 35 U.S.C. §§ 101 and 121;
2. Whether claims 8-9, 11 and 16-18 were properly rejected under 35 U.S.C. § 102(e) as being anticipated by *Gillespie*;

3. Whether claims 8–14 and 16–18 were properly rejected under 35 U.S.C. § 102(e) as being anticipated by *Marcyk et al*; and

4. Whether claims 15 and 20 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Marcyk et al* in view of *Van Buskirk et al*.

GROUPING OF CLAIMS

Claims 1–20 are pending in the present application. Claims 1–7 were restricted from claims 8–20 pursuant to 35 U.S.C. §§ 101 and 121 and withdrawn from further consideration. Claims 8–9, 11 and 16–18 were rejected under 35 U.S.C. § 102(e) as being anticipated by *Gillespie*. Claims 8–14 and 16–18 were rejected under 35 U.S.C. § 102(e) as being anticipated by *Marcyk et al*. Claims 15 and 20 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Marcyk et al* in view of *Van Buskirk et al*. Claim 19 was rejected under 35 U.S.C. § 103(a) as being unpatentable over *Marcyk et al* in view of *Joshi et al*. For purposes of this appeal, the pending claims will be grouped together as follows:

Group A – claims 1–7;

Group B – claims 8–20;

Group C – claim 12;

Group D – claims 15 and 20;

Group E – claim 17;

Group F – claim 19.

Groups A–F stand or fall independently. Patentability of the claims within each group is argued separately below.

ARGUMENT

Group A (Claims 1–7)

Claims 1–7 of Group A were restricted from claims 8–20 pursuant to 35 U.S.C. §§ 101 and 121 and withdrawn from consideration. These claims are properly grouped together and considered separately from the claims of Groups B–F since the claims of Group A are subject to a different grounds of rejection than the claims of Groups B–F.

The original Restriction Requirement asserted that the method claims (1–7) and the structure claims (8–20) are distinct because the structure of claims 8 and 16 may be manufactured by a materially different process than that recited in claim 1. In response to Appellant’s Brief on Appeal, a new Restriction Requirement was asserted. The new Restriction Requirement characterizes claims 8–20 (Group I) as drawn to “an intermediate device” and claims 1–7 as drawn to “a method of making a semiconductor device.”

Restriction is only proper where the claims are independent or distinct. MPEP § 806, p. 800-39 (8th ed. rev. 1 February 2003). In passing on questions of restriction, the claimed subject matter must be compared in order to determine distinctness and independence. MPEP § 806.01, p. 800-39.

Both the original Restriction Requirement and the new Restriction Requirement concede that the claims are not independent (i.e., are related), but the new Restriction Requirement incorrectly

states the relationship among the inventions claimed. Claims 1–7 are directed to a process of making a product, which process may be employed to make either an intermediate product or a final product. Claims 8–15 are directed to the intermediate product that may be made by the process. Claims 16–20 are directed to the final product that may be made by the process. Claims 1–7 and claims 8–20 are thus related as a process for making and the product made, while claims 8–15 and claims 16–20 are related as intermediate-final product species.

Accordingly, to establish distinctness of claims 1–7 from claims 8–20 (or distinctness of claims 1–7 from either claims 8–15 or claims 16–20), either or both of the following must be shown: (A) that the process *as claimed* is not an obvious process of making the product and the process *as claimed* can be used to make other and different products; or (B) that the product *as claimed* can be made by another and materially different process. MPEP § 806.05(f), p. 800-45 (emphasis in original). To establish distinctness of claims 8–15 from claims 16–20, a showing must be made that (A) the intermediate and final product have a mutually exclusive species relationship and, as with all species restrictions, are patentably distinct (typically found in cases in which the intermediate product loses its identity in transformation to the final product); and (B) the intermediate is useful to make other than the final product. MPEP § 806.04(b), p. 800-40. The examiner must give an example of such an alternative use. *Id.*

The original Restriction Requirement asserted that the product (claims 8–20) and the process (claims 1–7) are distinct because “etching, instead of chemical mechanical polishing, could be used

to remove portions of the protective barrier layer.” In the present application, pending independent claim 8 does not require removal of any portion of the protective barrier layer. Instead, claim 8 reads on a structure prior to removal of portions of the protective barrier layer (by, preferably, chemical mechanical polishing); as well as structures in which a protective barrier layer has been only partially removed (i.e., without complete removal over any area). The original Restriction Requirement thus fails to establish distinctness of claims 1–7 from claims 8–15 since independent claim 8 is directed to an intermediate product in which no removal of the protective barrier layer (whether by etching or chemical mechanical polishing) has necessarily been performed—that is, the original Restriction Requirement failed to establish that the product *as claimed* in claims 1–7 could be made by another and materially different process than the process *as claimed* in claims 8–15.

In addition, it is not apparent that the structure recited in pending independent claim 16 could be formed by etching rather than chemical mechanical polishing. Claim 16 recites a portion of a protective barrier layer over a central region of the tungsten and within the opening. Isotropic etching would uniformly remove a conformal protective barrier layer, while anisotropic etching for partial removal would remove the vertically thinner portions (e.g., at the center of an opening) leaving sidewalls alongside vertical or sloped surfaces. Neither type of etching would result in the structure recited in claim 16.

Still further, the original Restriction Requirement provides no basis for concluding that simple etching is materially different--i.e., patentably distinct--over chemical mechanical polishing.

Similarly, the Advisory Action mailed March 10, 2003 asserts that chemical mechanical polishing may be employed to form a trench for trench isolation. None of the pending claims recite trench isolation.

The new Restriction Requirement provides no factual basis for asserting distinctness of claims 1-7 from claims 8-20, making only the factually-unsupported statements:

Inventions I and II are related as mutually exclusive species in an intermediate-final product relationship. Distinctness is proven for claims in this relationship if the intermediate product is useful to make other than the final product (MPEP § 806.04(b), 3rd paragraph), and the species are patentably distinct (MPEP § 806.04(h)). In the instant case, the intermediate product is deemed to be useful as a circuit comprising a conformal tungsten layer and protective barrier layer formed over the substrate and the inventions are deemed patentably distinct since there is nothing on this record to show them to be obvious variants. Should applicant traverse on the ground that the species are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case.

Paper No. 13, page 2. A restriction requirement must provide the particular factual basis for asserting that restriction is necessary:

The particular reasons relied on by the examiner for holding that the inventions as claimed are either independent or distinct should be concisely stated. A mere statement of conclusion is inadequate. The reasons upon which the conclusion is based should be given.

MPEP § 816, p. 800-56. The restriction requirement fails to provide such a factual basis (as opposed to a "mere statement of conclusion") indicating why the claims recite patentably distinct species--that is, a factual basis for asserting that: (a) "the intermediate product is useful to make other than the final product"; and (b) "the species are patentably distinct."

With respect to distinctness of claims 8–15 from claims 16–20, the restriction requirement fails to satisfy any of the requirements for establishing distinctness of the intermediate and final products.

In response to the assertion within the Notice of Non-Compliance that the restriction is “non-appealable,” Appellant is aware of *In re Hengehold*, 440 F.2d 1395 (CCPA 1971), holding that restriction is outside the jurisdiction of the Board of Patent Appeals and Interferences (BPAI). However, the distinction drawn in that decision that restriction is not a “rejection” of claims since the applicant is free to pursue restricted claims in a separate application is unpersuasive and contrived. Any action other than allowance of a claim is inherently a rejection of the claim, or refusal to grant a patent including that claim. Moreover, Appellants note that the principle of double-patenting, which precludes multiple patents on the same invention or obvious variants thereof, is the complement to restriction, which prevents a single patent from protecting more than one invention (other than obvious variants). Double patenting, however, is not excluded from review by the BPAI, as is restriction.

In addition, Appellants believe that reconsideration of *Hengehold* is warranted by the absence of any meaningful review in current restriction practice. Baseless restriction requirements¹ entered simply to meet an action deadline, spread examination over multiple applications, and/or generate

¹ “Requirement” is actually a misnomer, since restriction is a refusal to allow claims and the associated requirement is for election of certain claims by the applicant.

additional fee revenue have become common due to the absence of any meaningful recourse for applicants in obtaining review and reversal of such baseless restriction requirements. In the present case, for instance, the new Restriction Requirement tacitly concedes the absence of merit in the original Restriction Requirement. Applicants followed the Patent Office's established procedure for seeking review of a restriction requirement, including requesting reconsideration and filing a Petition under 37 C.F.R. § 1.144 (which petitions are nominally decided by the appropriate Technology Center Director; see MPEP § 1002.02(c), p. 1000-7). Instead of a decision on the Petition, however, the matter was merely returned to the Examiner for entry of an additional—and equally baseless—restriction requirement. This tactic prevents the issue of the restriction from becoming sufficiently ripe to institute litigation against the Commissioner seeking independent review.

While generating additional revenue for the Patent Office, meritless restriction requirements of the type asserted in this application are onerous to an applicant, at least doubling (from \$8,620.00 to \$17,240.00) the cost of obtaining and maintaining a patent on a single invention and/or obvious variants. Even so, however, payment of the additional Patent Office fees is generally cheaper than initiating litigation to obtain independent review of the restriction. However, such acquiescence in meritless restriction requirements, while understandable, allows multiple patents to issue on a single invention or obvious variants, in contravention of the principles underlying double-patenting rejections. In light of the Commissioner's failure to provide for meaningful review of restriction requirements, and the Commissioner's conflicting interest in collecting additional fee revenue

through restriction practice, Appellants believe review and modification of the questionable decision in *Hengehold* is warranted.

Group B (Claims 8–20)

Claims 8–9, 11 and 16–18 of Group B were rejected under 35 U.S.C. § 102(e) as being anticipated by *Gillespie*. Claims 8–14 and 16–18 of Group B were rejected under 35 U.S.C. § 102(e) as being anticipated by *Marcyk et al.* Claims 15 and 20 of Group B were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Marcyk et al* in view of *Van Buskirk et al.* Claim 19 of Group B was rejected under 35 U.S.C. § 103(a) as being unpatentable over *Marcyk et al* in view of *Joshi et al.* These claims are properly grouped together and considered separately from the claims of Groups A and C–F since the claims are subject to a different grounds of rejection than the claims of Group A and since a favorable decision with respect to the claims of Group B may obviate the need for consideration of the claims of Groups C–F.

A claim is anticipated only if each and every element is found, either expressly or inherently described, in a single prior art reference. The identical invention must be shown in as complete detail as is contained in the claim. MPEP § 2131 at p. 2100–70 (8th ed. rev. 1 February 2003).

Independent claims 8 and 16 each recite that the protective barrier layer overlies the tungsten and is disposed within the opening through the dielectric. That is, independent claims 8 and 16 are directed to the second embodiment described above and depicted in Figures 2A–2B, in which the tungsten layer 200 is thinner than the unfilled portions of the openings 102–104 within dielectric

layer 100 and portions 202 of protective barrier material 108 therefore remain over the tungsten regions 201 and within the openings 102–104 after chemical mechanical polishing. Such a feature is not found in the cited reference(s), taken alone or in combination.

The structure of Figure 1F of *Gillespie*, cited in the Office Action as anticipating the claims of Group B, depicts tungsten 9 within an opening in dielectric 3 and overlying titanium nitride region 11 above the opening in dielectric layer 3 rather than within the opening in dielectric 3:

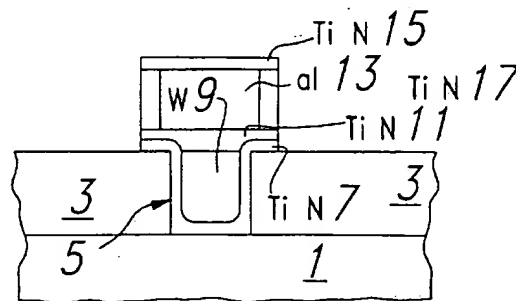


Fig. 1f

Gillespie, Figure 1f. In fact, Figure 1f within *Gillespie* is erroneous since the structure depicted is

formed from a structure more than fills the dielectric layer 3, and spaced apart from the top thickness of titanium

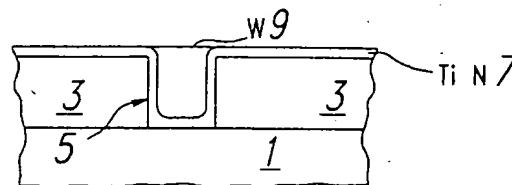


Fig. 1b

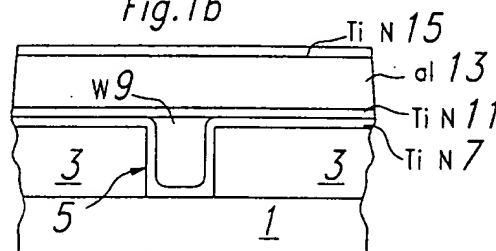


Fig. 1c

in which the tungsten 9 opening 5 within the titanium nitride 11 is of the opening by the nitride layer 7:

Gillespie, Figures 1b and 1c, column 2, lines 40–60. *Gillespie* is silent as to forming titanium within the opening 5 in dielectric layer 3.

Both independent claims of Group B recite that the protective barrier layer is formed within the opening(s). Independent claim 8 of Group B recites “a protective barrier layer over the tungsten layer and within the openings,” and thus reads on the structure depicted in Figure 2A. Independent claim 16 recites “a portion of a protective barrier layer over a central region of the tungsten and within the opening,” and thus reads on the structure depicted in Figure 2B. In these embodiments of the invention, the tungsten layer 200 is formed with a thickness insufficient to fill the openings 102–104 and the overlying protective barrier layer 108 fills any remainder of openings 102–104 not filled by tungsten layer 200. Specification, Figures 2A–2B, page 14, 9–14. The protective barrier layer is thus disposed within the openings 102–104, as well as over the tungsten layer 200.

The Office Action relies on an interpretation of “within the opening” as requiring only that the titanium nitride lie within a boundary defined by sidewalls of the opening, without necessarily extending into the opening (i.e., below the upper surface of the dielectric). Such an interpretation is contrary to the ordinary meaning of the term “within” and to the specification, and is therefor

without basis in the record and arbitrary and capricious. The interpretation adopted in the Office Action would be appropriate to the recitation "above the opening," but is contrary to the plain meaning of "within the opening."

Group C (Claim 12)

Claim 12 of Group C was rejected under 35 U.S.C. § 102(e) as being anticipated by *Marcyk et al.* This claim is properly considered separately from the claims of Groups A–B and D–F since the claim is subject to a different grounds of rejection than the claims of Group A and since the claim of Group B contains a limitation distinguishing the claimed invention over the cited references that is not recited in the claims of Groups B and D–F.

Claim 12 of Group C recites that the protective barrier layer--which is within the opening as recited in independent claim 8--overlies portions of the tungsten layer within the openings but not portions of the tungsten layer over the dielectric layer--that is, the claim recited the structure after partial removal or etch back of the protective barrier layer and tungsten metal layer, similar to the structure of Figure 1B except that the protective barrier material is within the opening, not merely over the opening. Such a feature is not found within the cited reference. None of the references, taken alone or in combination, depicts a protective barrier layer over a tungsten layer and within an opening, but only over tungsten within the opening and not also over tungsten overlying the dielectric including the opening.

Group D (Claims 15 and 20)

Claims 15 and 20 of Group D were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Marcyk et al* in view of *Van Buskirk et al*. These claims are properly considered separately from the claims of Groups A–C and E–F since the claims are subject to a different grounds of rejection than the claims of Group A and since the claims of Group D contain a common limitation distinguishing the claimed invention over the cited references that is not recited in the claims of Groups B–C and E–F.

In *ex parte* examination of patent applications, the Patent Office bears the burden of establishing a *prima facie* case of obviousness. MPEP § 2142, p. 2100-123 (8th ed. rev. 1 February 2003). Absent such a *prima facie* case, the applicant is under no obligation to produce evidence of nonobviousness. *Id.*

To establish a *prima facie* case of obviousness, three basic criteria must be met: First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. MPEP § 2142 at p. 2100-124.

Claims 15 and 20 each recite that at least one opening within the dielectric layer is sized to form a capacitive electrode from tungsten within the opening. Such a feature is not suggested by the

cited references, taken alone or in combination. *Van Buskirk et al*, cited in the Office Action as providing motivation for modifying the teachings of *Marcyk et al* to include such a feature, employs a protective barrier layer under the interconnect for etch stop point detection, and also relates to a trench capacitor rather than a capacitive electrode for an MOS capacitor. Moreover, the mere suitability of tungsten metal for use as a capacitor electrode does not provide a motivation for use of the specific structure shown in *Marcyk et al* to form a capacitive electrode, particular since formation of a trench capacitor as taught by *Van Buskirk et al* is not attended by the dishing problems associated with large area MOS capacitor electrodes.

Group E (Claim 17)

Claim 17 of Group E was rejected under 35 U.S.C. § 102(e) as being anticipated by *Gillespie*. Claim 17 of Group E was also rejected under 35 U.S.C. § 102(e) as being anticipated by *Marcyk et al*. This claim is properly considered separately from the claims of Groups A–D and F since the claim is subject to a different grounds of rejection than the claims of Group A and since the claim of Group E contains a limitation distinguishing the claimed invention over the cited references that is not recited in the claims of Groups B–D and F.

Claim 17 of Group E recites that a upper surface of the tungsten is exposed around the portion of the protective barrier layer within the opening over a central region of the tungsten within the opening. Such a feature is not found in the cited references. None of the cited references, taken

alone or in combination, depicts or describes a protective barrier layer that is both within an opening and exposes portions of an underlying tungsten layer around the protective barrier layer.

Group F (Claim 19)

Claim 19 of Group F was rejected under 35 U.S.C. § 103(a) as being unpatentable over *Marcy et al* in view of *Joshi et al*. This claim is properly considered separately from the claims of Groups A–E since the claim is subject to a different grounds of rejection than the claims of Group A and since the claim of Group F contains a limitation distinguishing the claimed invention over the cited references that is not recited in the claims of Groups B–E.

Claim 19 of Group F recites that the tungsten and the protective barrier layer form an upper surface substantially planar with an upper surface of the dielectric layer. Such a feature is not found in the cited references. *Marcy et al* depicts protective barrier region 208b, 308b above the upper surface of dielectric layer 202, 302. *Joshi et al* describes a titanium nitride layer below a tungsten metal region 17, not over the tungsten metal as recited in the claims. Nothing in either references suggests that the respective teachings may be successfully combined and modified to achieve the claimed invention, with a protective barrier layer and underlying tungsten metal forming an upper surface substantially planar with the dielectric.

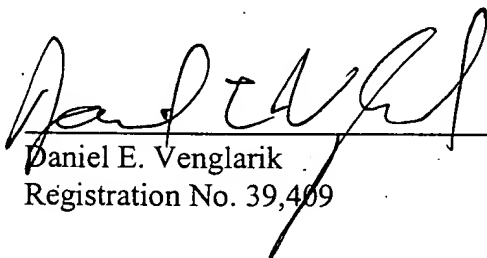
CONCLUSION

The restriction of the claims of Group A has no basis in the claims and is unsupported by any evidence of record. Therefore, the restriction under 35 U.S.C. §§ 101 and 121 is improper. None of the cited references, taken alone or in combination, depict or describe all features of the invention claimed in Groups B-F. Therefore, the rejections under 35 U.S.C. §§ 102 and 103 are improper. Applicant respectfully requests that the Board of Appeals reverse the decision of the Examiner below restricting the claims of Group A and rejecting all remaining pending claims in the application.

Respectfully submitted,

DAVIS MUNCK, P.C.

Date: 12-1-03


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APPENDIX TO APPELLANT'S SUBSTITUTE BRIEF ON APPEAL
PENDING CLAIMS ON APPEAL

1. A method of forming a conductive structure within an integrated circuit comprising:
 - forming a conformal tungsten layer over a dielectric layer and within openings within the dielectric layer;
 - forming a protective barrier layer over the tungsten layer, wherein the protective barrier layer comprises a material for which removal by chemical mechanical polishing is primarily mechanical;
 - and
 - removing at least portions of the protective barrier layer and the tungsten layer by chemical mechanical polishing.
2. The method as set forth in Claim 1 wherein the step of forming a protective barrier layer over the tungsten layer further comprises:
 - forming a titanium or titanium nitride layer on the tungsten layer.

1 3. The method as set forth in Claim 2 wherein the step of removing at least portions of the
2 protective barrier layer and the tungsten layer by chemical mechanical polishing further comprises:
3 removing portions of the tungsten layer overlying the dielectric layer without removing
4 portions of the tungsten layer within the openings within the dielectric layer.

1 4. The method as set forth in Claim 3 wherein the step of removing at least portions of the
2 protective barrier layer and the tungsten layer by chemical mechanical polishing further comprises:
3 removing all of the protective barrier layer.

1 5. The method as set forth in Claim 3 wherein the step of removing at least portions of the
2 protective barrier layer and the tungsten layer by chemical mechanical polishing further comprises:
3 removing portions of the protective barrier layer overlying dielectric regions between the
4 openings within the dielectric layer.

1 6. The method as set forth in Claim 5 wherein the step of removing at least portions of the
2 protective barrier layer and the tungsten layer by chemical mechanical polishing further comprises:

3 after removing portions of the protective barrier layer overlying the dielectric regions
4 between the openings within the dielectric layer, removing portions of the tungsten layer overlying
5 the dielectric regions between the openings within the dielectric layer; and

6 during removal of portions of the tungsten layer overlying the dielectric regions between the
7 openings within the dielectric layer, removing portions of the protective barrier layer overlying the
8 openings within the dielectric layer.

1 7. The method as set forth in Claim 2 wherein the step of removing at least portions of the
2 protective barrier layer and the tungsten layer by chemical mechanical polishing further comprises:

3 removing portions of the protective barrier layer and the tungsten layer overlying dielectric
4 regions between the openings within the dielectric layer to planarize remaining portions of the
5 tungsten layer and remaining portions of the protective barrier layer, if any, with the dielectric layer.

1 8. A portion of an integrated circuit structure comprising:
2 a dielectric layer over a substrate;
3 a conformal tungsten layer over the dielectric layer and within openings within the dielectric
4 layer; and
5 a protective barrier layer over the tungsten layer and within the openings, wherein the
6 protective barrier layer comprises a material for which removal by chemical mechanical polishing
7 is primarily mechanical.

1 9. The portion of an integrated circuit structure as set forth in Claim 8 wherein the protective
2 barrier layer is titanium or titanium nitride.

1 10. The portion of an integrated circuit structure as set forth in Claim 8 wherein portions of the
2 tungsten layer within the openings are thicker than portions of the tungsten layer over the dielectric
3 layer.

1 11. The portion of an integrated circuit structure as set forth in Claim 8 wherein the protective
2 barrier layer overlies the entire tungsten layer.

1 12. The portion of an integrated circuit structure as set forth in Claim 8 wherein the protective
2 barrier layer overlies portions of the tungsten layer within the openings but not portions of the
3 tungsten layer over the dielectric layer.

1 13. The portion of an integrated circuit structure as set forth in Claim 8 wherein the tungsten
2 layer has a thickness of between about 4500 and 8000 angstroms.

1 14. The portion of an integrated circuit structure as set forth in Claim 8 wherein the protective
2 barrier layer has a thickness of between about 100 and 800 angstroms.

1 15. The portion of an integrated circuit structure as set forth in Claim 8 wherein at least one
2 opening within the dielectric layer is sized to form a capacitive electrode from tungsten within the
3 at least one opening.

1 16. A portion of an integrated circuit structure comprising:
2 a dielectric layer having an opening therein;
3 tungsten within the opening; and
4 a portion of a protective barrier layer over a central region of the tungsten and within the
5 opening, wherein the portion of the protective barrier layer comprises a material for which removal
6 by chemical mechanical polishing is primarily mechanical.

1 17. The portion of an integrated circuit structure as set forth in Claim 16 wherein an upper
2 surface of the tungsten is exposed around the portion of the protective barrier layer.

1 18. The portion of an integrated circuit structure as set forth in Claim 16 wherein the portion of
2 the protective barrier layer is titanium or titanium nitride.

1 19. The portion of an integrated circuit structure as set forth in Claim 16 wherein the tungsten
2 and the portion of the protective barrier layer form an upper surface which is substantially planar
3 with an upper surface of the dielectric layer.

1 20. The portion of an integrated circuit structure as set forth in Claim 16 wherein the opening
2 within the dielectric layer is sized to form a capacitive electrode from the tungsten within the
3 opening.